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(56) Documents Cited
US 4827111 A US 4701601 A

(58) Field of Search
UK CL (Edition L) B6A AK
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(54) Smart card with LCD and energy store for receiving external power

(57) A smart card (100) comprises an electronic data memory (110); an interface unit (160) connected to the data memory, to allow access to the data memory by an external card accessing apparatus (170); and a liquid crystal display (120) operable to display information indicative of the contents of the data memory. The display (120) is powered externally by the card accessing apparatus (170), an energy store (150) e.g. a capacitor, being provided to power the display after interaction with the apparatus (170) has finished.

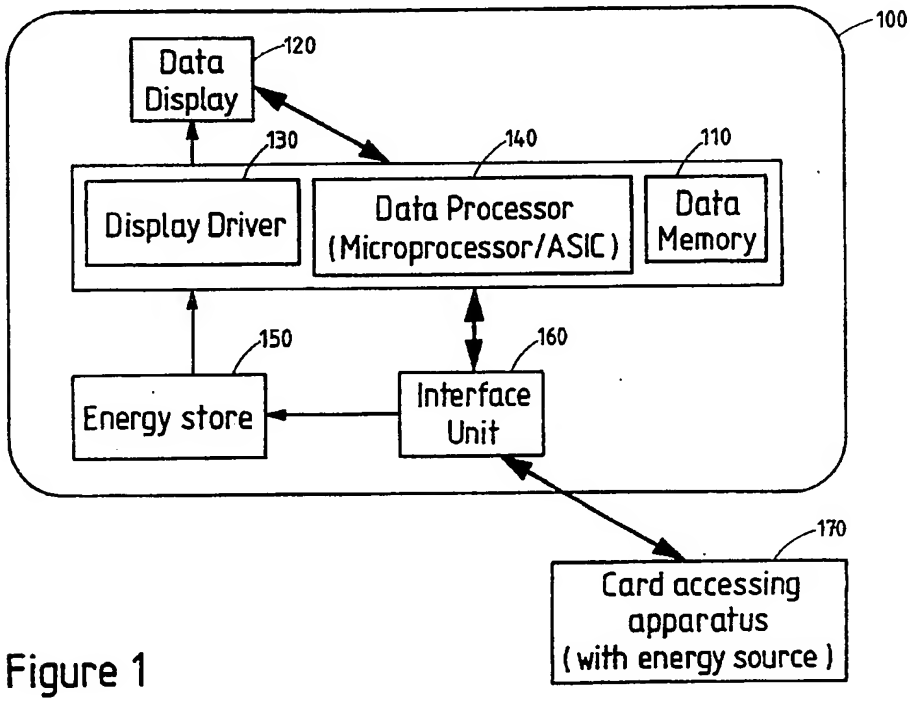

Figure 1

GB 2 275 654 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

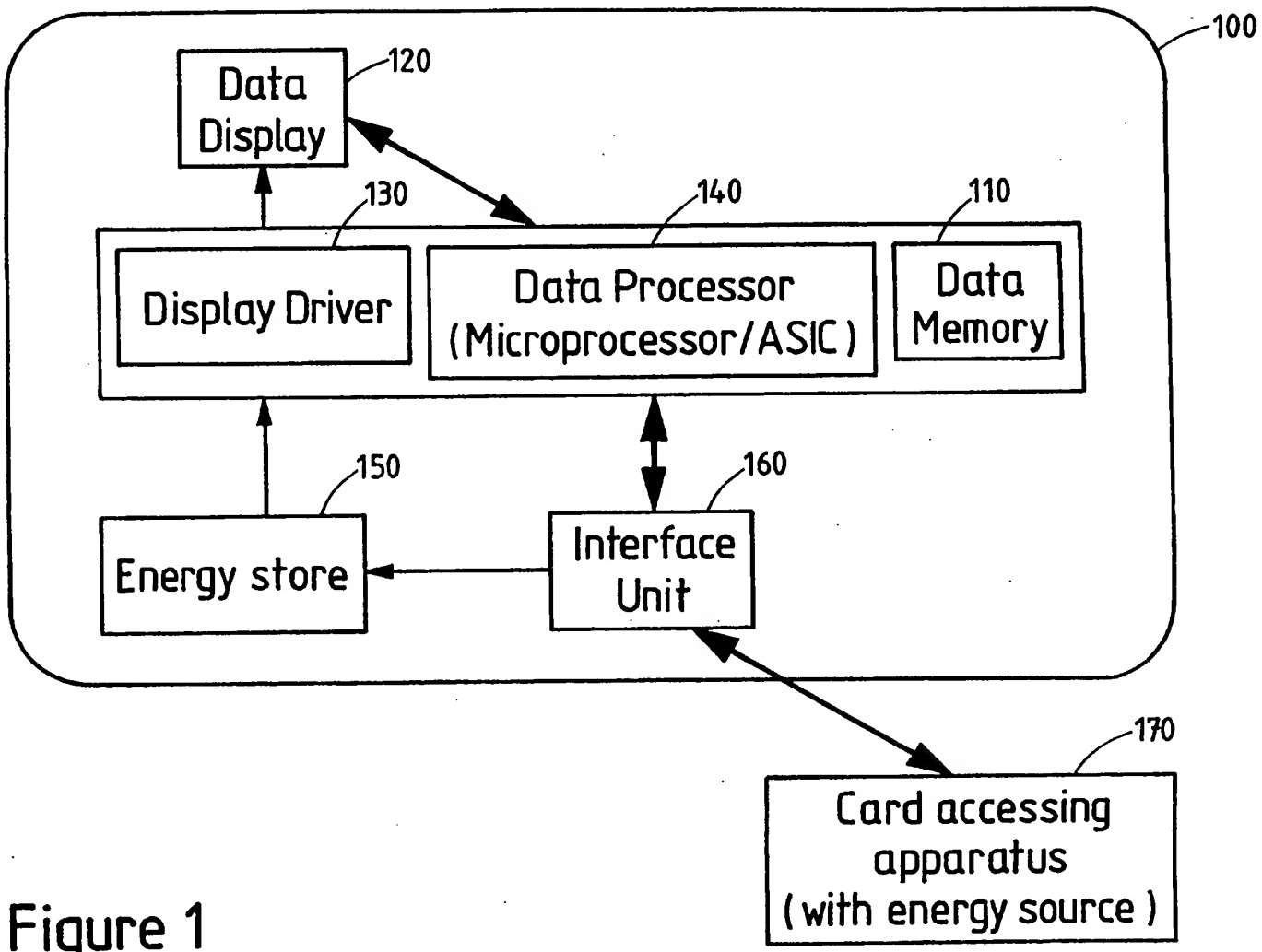
100
Data Display
120
130
140
110
Display Driver
Data Processor (Microprocessor/ASIC)
Data Memory
150
160
Energy store
Interface Unit
170
Card accessing apparatus (with energy source)

Figure 1

SMART CARD

This invention relates to smart cards.

Smart cards are small electronic devices comprising an electronic data memory, the contents of which may be modified by an external card accessing device. They are increasingly being used in place of more traditional transaction cards (e.g. credit or identification cards) in which data are recorded on a magnetic strip.

Smart cards are generally similar in size to standard credit cards (approximately 85 x 55 mm). Although smart cards may be more expensive to manufacture than cards employing magnetic strips, they do offer a number of recognised advantages over such cards. These advantages relate to the additional data storage capacity achieved by using electronic memories rather than magnetic recording, and to the fact that the cards can include active data processing elements in addition to the data storage functions provided by the data memory.

In order to perform a transaction such as an electronic payment, a smart card must interact with a separate card accessing apparatus so that the accessing apparatus may read the contents of the data memory held on the card. A connection between the smart card and the card accessing apparatus may be made through complementary sets of electrical contacts mounted on the smart card and the apparatus, or through complementary induction coils housed in the smart card and the apparatus. In either case, the connection may also be employed to provide power to the smart card for the duration of the transaction. Information relating to the transaction (such as the amount of the payment, a cash balance held on the card and card identification data) may be displayed on the card reading apparatus while the transaction is being performed.

This invention provides a smart card comprising: an electronic data memory; an interface means connected to the data memory, to allow access to the data memory by an external card accessing apparatus; and a data display operable to display information indicative of the contents of the data memory.

A smart card according to the invention incorporates a data display operable to display information indicative of the data held by the card. This means that the user is able to ascertain the contents

of the data memory in between transactions involving the smart card. For example, if the data memory stores a cash balance (or the equivalent) for use in a cashless payment system, the data display may be used to indicate the remaining cash balance at various times between successive transactions.

Preferably the interface means comprises means cooperable with a card accessing apparatus for receiving electrical energy from the card accessing apparatus to power the display. This avoids the need to provide a power source (such as a battery) on the smart card in order to power the display.

In one preferred embodiment, in order that the information may be displayed for longer than the duration of a transaction, the smart card comprises means for storing electrical energy received from the card accessing apparatus. This may be achieved by employing means for activating the display to display the information for a predetermined time. Preferably, to avoid the need to provide user-operated controls on the smart card itself, the means for activating is responsive to an access to the data memory by a card accessing apparatus.

Preferably the display comprises one or more permanent legends, in order to increase the intelligibility of the displayed information.

It is preferred that the display comprises a liquid crystal display, because of the particularly low power consumption of this family of displays. A preferred type of liquid crystal display is the so-called twisted nematic liquid crystal display.

In another preferred embodiment, the display is driven to display the information by an electrical display signal and continues to display that information after removal of the display signal. The use of a bistable display of this type means that the information indicative of the contents of the data memory (for example, a cash balance or a number of payment units remaining) may displayed at all times between successive transactions. Various displays, such as so-called ferro-electric displays, could be used in this way; however, in a preferred embodiment the display comprises a smectic liquid crystal display.

Although the interface means may comprise complementary induction coils housed in the smart card and the card accessing apparatus, in an advantageously simple embodiment the interface means comprises a

plurality of electrical contacts mounted on the smart card, for cooperating with complementary contacts mounted on a card accessing apparatus.

In order that active data processing operations may be performed by the smart card, it is preferred that the smart card comprises a data processor connected to the interface means, the data memory and the display.

Preferably the data memory is operable to store data relating to financial transactions; and the display is operable to display information relating to a most recent one of the financial transactions.

Viewed from a second aspect this invention provides a smart card comprising: an electronic data memory; an interface means connected to the data memory, to allow access to the data memory by an external card accessing apparatus, the interface means comprising means cooperable with a card accessing apparatus for receiving electrical energy from the card accessing apparatus; and means for storing electrical energy received from the card accessing apparatus.

The invention will now be described by way of example with reference to the accompanying drawing, in which:

Figure 1 is a schematic block diagram of a smart card according to the invention.

Referring now to Figure 1, a smart card 100 comprises a data memory 110, a liquid crystal (LCD) data display 120, a display driver 130, a data processor 140 such as a microprocessor or an application-specific integrated circuit (ASIC), an energy store 150 and an interface unit 160.

The smart card 100 is formed as a thin rectangular plastics card conforming to a standard size of 85 mm long, 55 mm wide and about 1 to 5 mm thick. The data memory 110, the display driver and the data processor 140 are fabricated as a single integrated circuit housed within the plastics card.

One function of the interface unit 160 is to provide a data interface between the data memory 110 and an external card accessing apparatus 170 (e.g. a card reader). In order to establish such an interface, an electrical connection between the interface unit 160 and the card accessing apparatus 170 is required. In the present

embodiment, this is achieved by forming a physical connection between a number of electrical contacts on the smart card and complementary contacts on the card accessing apparatus 170. In this case, the physical connection can be formed reliably by placing the smart card into a card-receiving slot on the card accessing apparatus.

The interface unit 160 also provides a power supply connection between the smart card and the card accessing apparatus. This means that the electronic circuitry contained within the smart card can be powered by a power source in the accessing apparatus for the time in which the accessing apparatus is interacting with the smart card. This avoids the need to provide a power source (such as a battery) in the smart card itself, but requires that the data memory 110 is a non-volatile random access memory (i.e. the contents of the data memory are not lost when power is removed from the memory).

When a power supply connection is established between the interface unit 160 and the card accessing apparatus 170, electrical energy is stored in the energy store 150 (e.g. a capacitor). As described below, the stored electrical energy is used to power the data display 120 after the interaction between the smart card 100 and the card accessing apparatus has finished.

An alternative type of connection between the interface unit and the card accessing apparatus may be provided by complementary induction coils housed within the smart card and the accessing apparatus. Data and power can be transmitted between the complementary coils by electromagnetic induction. This system avoids the requirement of physical contact between the smart card and the accessing apparatus, at the expense of a more complicated interface unit.

The data memory 110 stores data relating to, for example, financial transactions or security identification, depending on the particular application of the card. For example, a smart card in which the data memory 110 stores data representing a cash balance can be used as part of a cashless payment system. When a payment is to be made, the smart card is first connected to a card accessing apparatus by means of the interface unit 160. The card accessing apparatus then makes various security checks before reading the current cash balance held in the data memory 110, deducting the amount of the payment from that balance, and finally writing the modified balance back into the

data memory 110.

The data display 120 displays information indicative of the contents of the data memory 110. This information may be, for example, a current cash balance held by the data memory 110, the amount of the most recent payment made using the smart card (i.e. reflecting the most recent change to the contents of the data memory, and acting as an electronic receipt for the transaction), security authorisation information or the like. The display driver 130 is activated at the start of a transaction in which the card accessing unit reads from or writes to the data memory 110, and remains activated for a predetermined period after termination of that transaction. During the predetermined period after the end of the transaction, the data display 120 is powered by the electrical energy stored in the energy store 150 during the transaction. A suitable type of display device for use in this embodiment is the so-called twisted nematic liquid crystal display. In order to increase the intelligibility of the displayed information, the data display may be annotated with permanent legends such as the words "current balance".

In an alternative embodiment, a bistable liquid crystal display is employed, such as a ferro-electric or smectic liquid crystal display. The data display is driven by the display driver 130 to display certain information while the transaction is taking place, and then continues to display that information after power has been removed. This type of display can therefore be used to provide a constant indication of the state of the data memory 110 (e.g. the remaining cash balance held by the card).

Smart cards according to the embodiments described above have potential uses in a number of commercial fields, such as:

Gaming and promotions;

Banking, credit and financial transactions;

Receipting of electronic payments;

Misuse, fraud and tamper evidence;

Information validation and/or control;

Advertising; and

Security access control.

CLAIMS

1. A smart card comprising:

an electronic data memory;

an interface means connected to the data memory, to allow access to the data memory by an external card accessing apparatus; and

a data display operable to display information indicative of the contents of the data memory.

2. A smart card according to claim 1, in which the interface means comprises means cooperable with a card accessing apparatus for receiving electrical energy from the card accessing apparatus to power the display.

3. A smart card according to claim 2, comprising means for storing electrical energy received from the card accessing apparatus.

4. A smart card according to any one of the preceding claims, comprising means for activating the display to display the information for a predetermined time.

5. A smart card according to claim 4, in which the means for activating is responsive to an access to the data memory by a card accessing apparatus.

6. A smart card according to any one of the preceding claims, in which the display comprises one or more permanent legends.

7. A smart card according to any one of the preceding claims, in which the display comprises a liquid crystal display.

8. A smart card according to claim 7, in which the display comprises a twisted nematic liquid crystal display.

9. A smart card according to any one of claims 1 to 3, in which the display is driven to display the information by an electrical display signal and continues to display that information after removal of the

display signal.

10. A smart card according to claim 7 and claim 9, in which the display comprises a smectic liquid crystal display.

11. A smart card according to any one of the preceding claims, in which the interface means comprises a plurality of electrical contacts mounted on the smart card, for cooperating with complementary contacts mounted on a card accessing apparatus.

12. A smart card according to any one of the preceding claims, comprising a data processor connected to the interface means, the data memory and the display.

13. A smart card according to any one of the preceding claims, in which:

the data memory is operable to store data relating to financial transactions; and

the display is operable to display information relating to a most recent one of the financial transactions.

14. A smart card comprising:

an electronic data memory;

an interface means connected to the data memory, to allow access to the data memory by an external card accessing apparatus, the interface means comprising means cooperable with a card accessing apparatus for receiving electrical energy from the card accessing apparatus; and

means for storing electrical energy received from the card accessing apparatus.

15. A smart card substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

8

Application number

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Relevant Technical fields

(i) UK Cl (Edition L) B6A (AK)

(ii) Int Cl (Edition 5) G06K

Search Examiner

G RUSSELL

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

28 MAY 1993

Documents considered relevant following a search in respect of claims 1-15

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	US 4827111 (CASIO) See LCD (1e) and external power source (co-a)	1, 2, 4, 7, 11 and 12
X	US 4701601 (VISA) See LCD (50)	1

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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